

**Biology**  
**Higher level**  
**Paper 1**

Wednesday 4 May 2016 (morning)

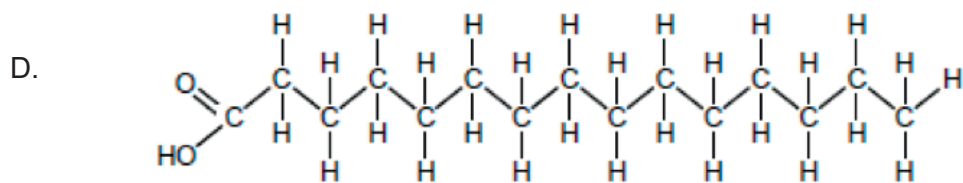
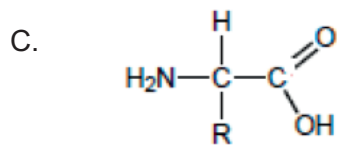
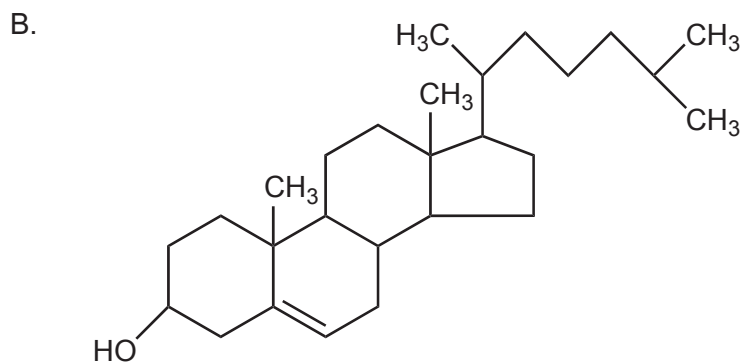
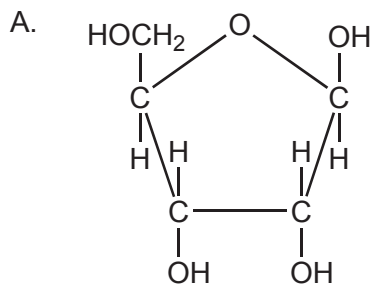
1 hour

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**Instructions to candidates**

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The maximum mark for this examination paper is **[40 marks]**.

1. Which molecule is a sugar?



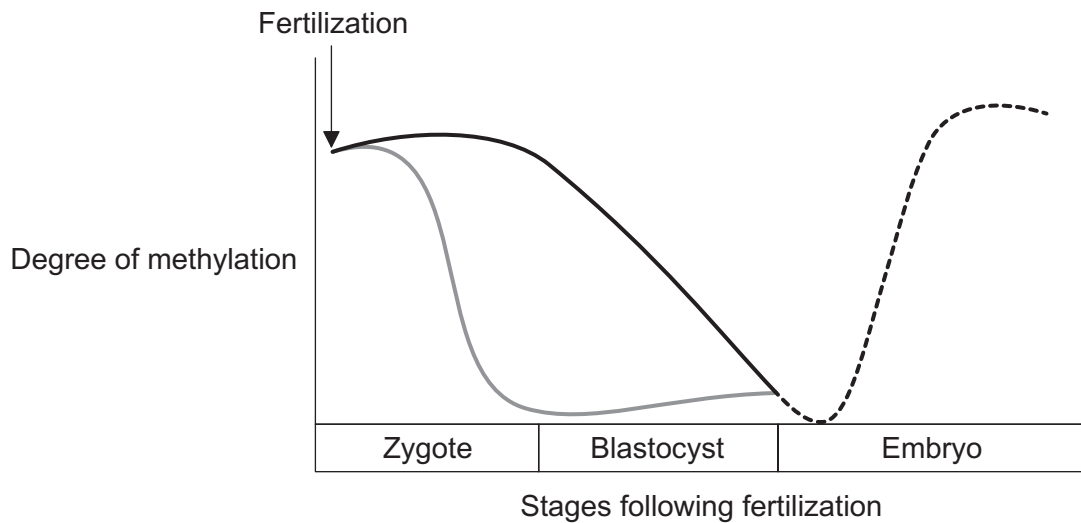
2. Why is sweat a good coolant for the body?

- A. The arterioles that transfer water to sweat move closer to the skin surface when it is hot.
- B. Breaking H bonds between water molecules in sweat requires energy from body heat.
- C. Sweat contains minerals such as sodium chloride.
- D. Sweat is non-polar.

3. Which molecule is a polysaccharide?
- A. Glucagon
  - B. Glucose
  - C. Glycerol
  - D. Glycogen
4. Which substance is used for structure in plants?
- A. Amylopectin
  - B. Cellulose
  - C. Collagen
  - D. Starch
5. What usually distinguishes DNA from RNA?

	DNA	RNA
A.	strands are symmetrical	strands are antiparallel
B.	contains adenine	contains cytosine
C.	pentoses linked to phosphates	pentoses linked to bases
D.	double stranded	single stranded

6. Very soon after fertilization, parental epigenetic methylation is reversed in the DNA. Later, tissue-specific epigenetic modifications are made to the embryonic DNA. The graph follows the degree of methylation from different sources during embryonic development.



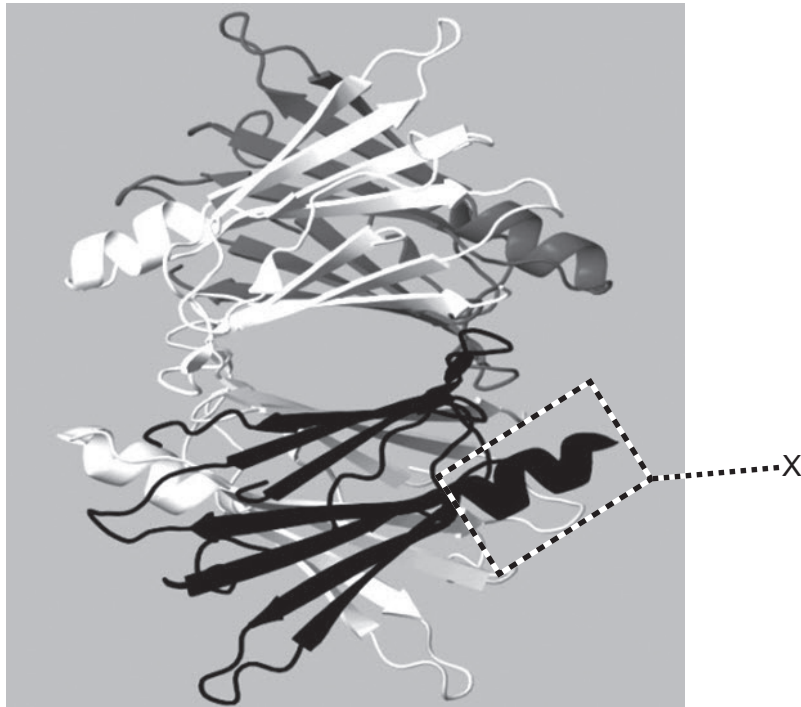
**Key:** — maternal DNA    — paternal DNA    ---- embryonic DNA

[Source: Sandra Rodriguez-Rodero, "Epigenetic regulation of ageing" *Discovery Medicine* 10 (52), 225–233, September 2010. Reprinted with permission.]

According to the graph, what are the changes in DNA methylation during embryonic development?

- A. Only the paternal DNA becomes demethylated.
  - B. The maternal DNA becomes demethylated first.
  - C. The methylation patterns of the parents' DNA are erased before fertilization.
  - D. The methylation patterns of both parents are erased after fertilization.
7. Which sequence of DNA would be suitable in DNA profiling?
- A. ---ATTCGTGAATCAGCC---
  - B. ---ATTCGTGAATTTGCC---
  - C. ---ATTCGTGATTGCAGC---
  - D. ---ATTCGTGATTCGTGA---

8. The image represents a model of the protein transthyretin.

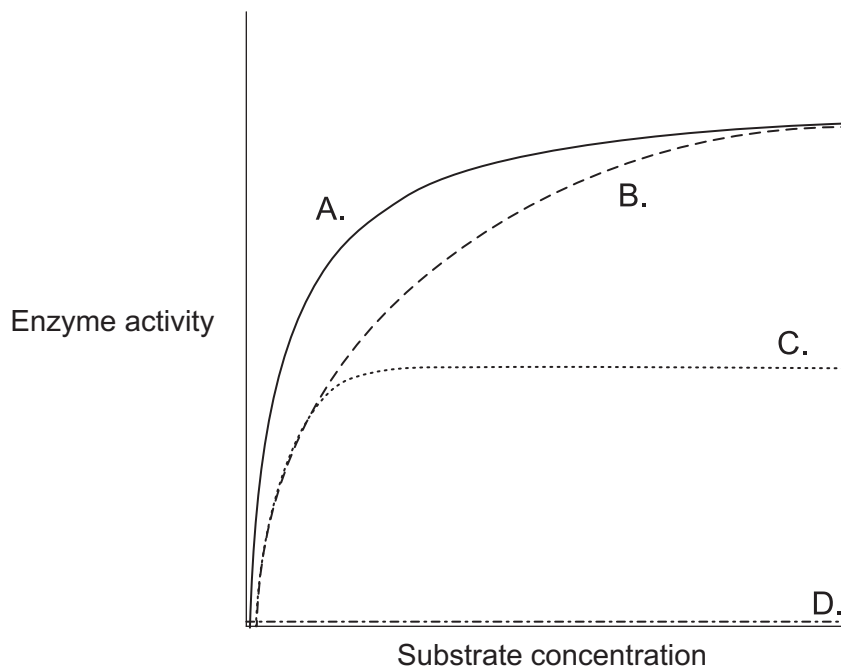


[Source: adapted from <http://en.wikipedia.org>]

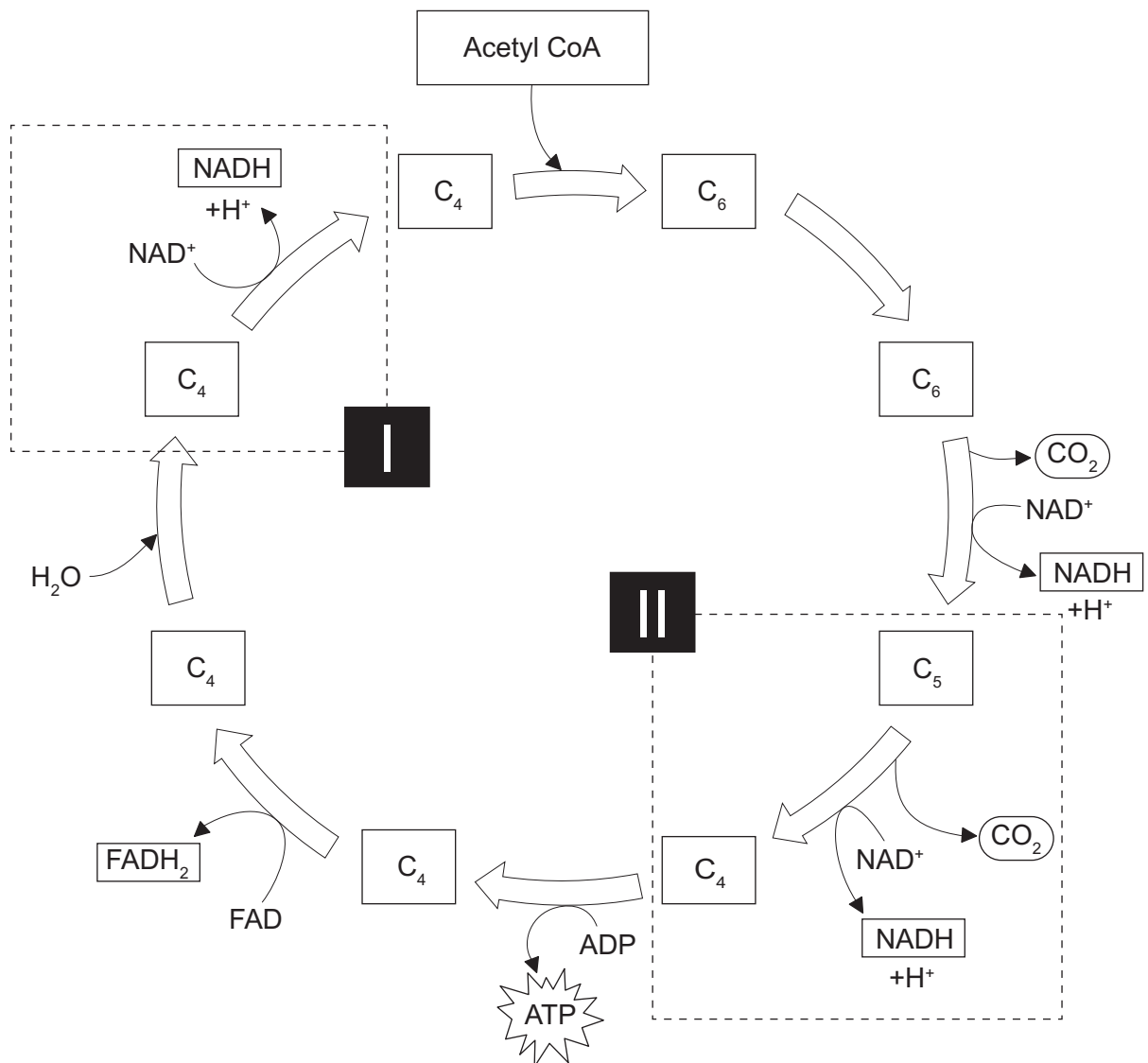
Which level of structure is indicated by X on the image?

- A. Primary
- B. Secondary
- C. Tertiary
- D. Quaternary

9. In one of the curves in the graph, the rate of an enzyme-catalysed reaction has been plotted against the substrate concentration in presence of a small quantity of a competitive inhibitor. Which curve represents competitive inhibition?



10. The diagram represents the Krebs cycle.



[Source: CAMPBELL, NEIL A.; REECE, JANE B., *BIOLOGY*, 7th, ©2005, p.68.  
Reprinted by permission of Pearson Education, Inc., New York, New York.]

What processes are occurring at I and II?

	Process I	Process II
A.	C <sub>4</sub> is being reduced	NAD <sup>+</sup> is being oxidized
B.	NAD <sup>+</sup> is being decarboxylated	C <sub>5</sub> is being oxidized
C.	NADH is being reduced	C <sub>5</sub> is being decarboxylated
D.	NAD <sup>+</sup> is being reduced	C <sub>5</sub> is being decarboxylated

11. Which gas produces most of the bubbles in bread dough?
- A. Oxygen
  - B. Methane
  - C. Carbon dioxide
  - D. Water vapour
12. Which molecule would first contain  $^{14}\text{C}$  if the alga *Chlorella* was grown in the presence of light and radioactive  $\text{CO}_2$ ?
- A. Glycerate 3-phosphate
  - B. Glucose
  - C. Rubisco
  - D. Ribulose biphosphate (RuBP)
13. What is the process shown in this image?



[Source: <http://www.slideshare.net/sciencepowerpointcom/bacterial-reproduction-biology-lesson-powerpoint-binary-fission>]

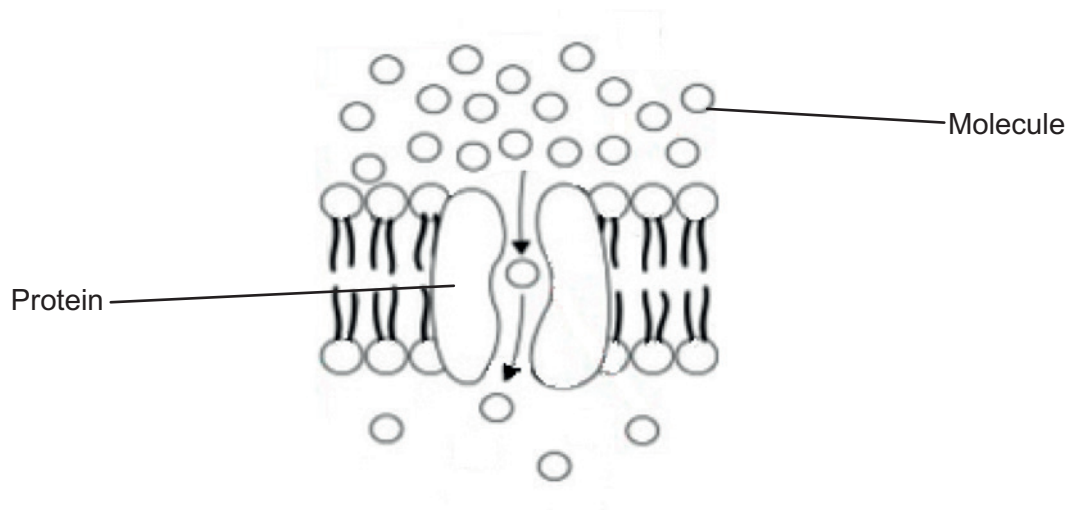
- A. Binary fission of a prokaryotic cell
- B. Telophase II in a eukaryotic cell
- C. End of mitosis in a prokaryotic cell
- D. Cytokinesis of a eukaryotic cell



14. What can be deduced about a striated muscle fibre from both of these statements?

“A eukaryotic cell has one nucleus.”  
“A striated muscle fibre has many nuclei.”

- A. It is prokaryotic.
  - B. It is an exception to cell theory.
  - C. It consists of aseptate hyphae.
  - D. It is preparing to divide.
15. The diagram is a model of one type of movement across a membrane.



[Source: CAMPBELL, NEIL A.; REECE, JANE B., *BIOLOGY*, 7th, ©2005, p. 134.  
Reprinted by permission of Pearson Education, Inc., New York, New York.]

What is this type of movement?

- A. Simple diffusion
- B. Facilitated diffusion
- C. Osmosis
- D. Active transport

- 16.** What is the mechanism of sodium-potassium pumps in neurons that generates a resting potential by active transport?
- A.  $K^+$  from cytoplasm binds to the pump and stimulates its phosphorylation by ATP.
  - B. Phosphorylation of the pump causes its shape change in order to move  $Na^+$  into the cytoplasm.
  - C.  $K^+$  from inside the cell binds to the pump and causes the release of the phosphate group.
  - D.  $Na^+$  from cytoplasm binds to the pump and stimulates its phosphorylation by ATP.
- 17.** What is characteristic of homologous chromosomes?
- A. They have an identical DNA sequence.
  - B. They are of the same length in karyograms.
  - C. They form pairs in prokaryotes.
  - D. They carry the same alleles.
- 18.** What event occurs only in meiosis?
- A. Fusion of gametes to promote genetic variation
  - B. Random separation of chromatids
  - C. Random separation of homologous chromosomes
  - D. Replication of chromosomes
- 19.** In which situation are alleles exchanged?
- A. During the separation of sister chromatids
  - B. In the transmission of linked genes
  - C. During fertilization when sperm and egg chromosomes pair up
  - D. When chiasmata are formed between non-sister chromatids

20. What is the effect of dominant alleles?

- I. They mask the effect of recessive alleles.
- II. They become more frequent than recessive alleles in a population.
- III. They have a joint effect with recessive alleles when characteristics are co-dominant.

- A. I only
- B. I and II only
- C. I and III only
- D. I, II and III

21. The statement is about the genetic control of cat coat colour.

Many genes control cat coat colour. Tabby cats have a coat with stripes. Two of their genes are the tabby gene *Mm* and the agouti gene *Aa*.

- The dominant allele **M** codes for straight stripes, whereas the recessive allele **m** codes for blotches and whorls instead of stripes.
- The dominant allele **A** produces two-toned hair, to reveal coat patterns, whereas the recessive allele **a** causes all coat hair to be black and so hides any pattern.

In a cross between two double heterozygous tabby cats, what would the expected proportion of black offspring be?

- A. 1 out of 16
- B. 3 out of 16
- C. 4 out of 16
- D. 9 out of 16

22. This is the cross that led to the discovery of non-Mendelian ratios in Morgan's experiments with *Drosophila*.

Grey body – Normal wings

$$\begin{array}{cc} b^+ & vg^+ \\ \hline b & vg \end{array}$$

×

Black body – Vestigial wings

$$\begin{array}{cc} b & vg \\ \hline b & vg \end{array}$$

Which is a recombinant genotype?

A. 
$$\begin{array}{cc} b^+ & vg^+ \\ \hline b & vg \end{array}$$

B. 
$$\begin{array}{cc} b & vg \\ \hline b & vg^+ \end{array}$$

C. 
$$\begin{array}{cc} b^+ & vg^+ \\ \hline b^+ & vg^+ \end{array}$$

D. 
$$\begin{array}{cc} b & vg \\ \hline b & vg \end{array}$$

23. Which are characteristics of a species?

- I. The potential to interbreed to produce fertile offspring
- II. The formation of a population with members of the same species within a community
- III. The overproduction of offspring

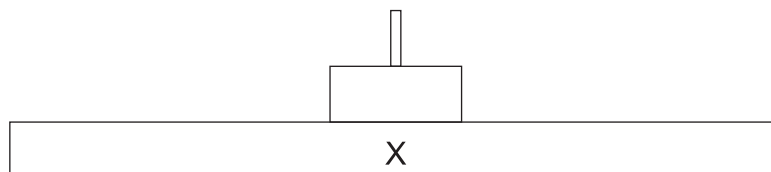
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

24. The statement is about the role of some bacteria in ecosystems.

“Bacteria play an important role in recycling nutrients in ecosystems. They live on organic wastes and dead organisms and digest their molecules. They then absorb some of these molecules for their own metabolism, and the rest is used by other organisms.”

What is the mode of nutrition of these bacteria?

- A. They are autotrophs.
  - B. They are consumers.
  - C. They are saprotrophs.
  - D. They are detritivores.
25. The diagram represents a pyramid of energy.



What level does the letter X represent?

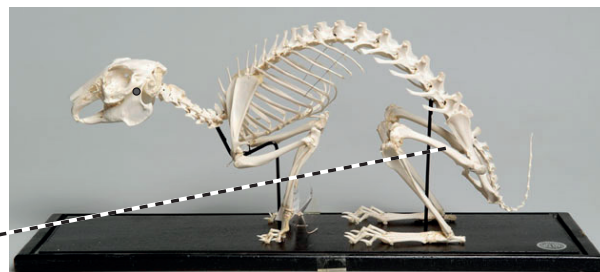
- A. Light
  - B. Primary consumers
  - C. Abiotic environment
  - D. Producers
26. How can molluscs and platyhelminthes be distinguished?
- A. Molluscs are unsegmented but platyhelminthes are segmented.
  - B. Molluscs have a mouth and an anus but platyhelminthes do not.
  - C. Molluscs are smooth but platyhelminthes have bristles.
  - D. Molluscs remain attached to rock but platyhelminthes move around in water.

27. Which is the most efficient way for some desert plants to conserve water?
- A. By having no leaves, so water evaporates from the green stem with less surface
  - B. By loading organic compounds in the phloem of the roots
  - C. By accumulating salt within their tissues, so water is retained by osmosis
  - D. By growing long hair on their surface, so air moisture is absorbed at night
28. What allows most plants to continue producing more roots, leaves or stems throughout their life?
- A. Auxin
  - B. Meristems
  - C. Phloem
  - D. Cellulose
29. How do most angiospermophyta improve sexual reproductive success?
- A. By flowering during long days
  - B. By flowering during short days
  - C. By using mutualistic pollinators
  - D. By using micropropagation
30. To which domain does *Carcharodon carcharias*, a shark, belong?
- A. Eukaryote
  - B. Consumer
  - C. Fish
  - D. Chordata

- Frog



Rabbit



What is the evolutionary relationship between X and Y?

- A. They are analogous.
- B. X is analogous and Y is homologous.
- C. They are homologous.
- D. They are neither homologous nor analogous.

- 32.** How can species of bacteria evolve to be resistant to antibiotics?

- I. A variation within one bacterium's genome confers resistance.
  - II. Antibiotics enable genes to become adapted through transcription and translation.
  - III. An incomplete dose of antibiotics allows bacteria with a high resistance to survive and reproduce.
- 
- A. I only
  - B. I and II only
  - C. I and III only
  - D. III only

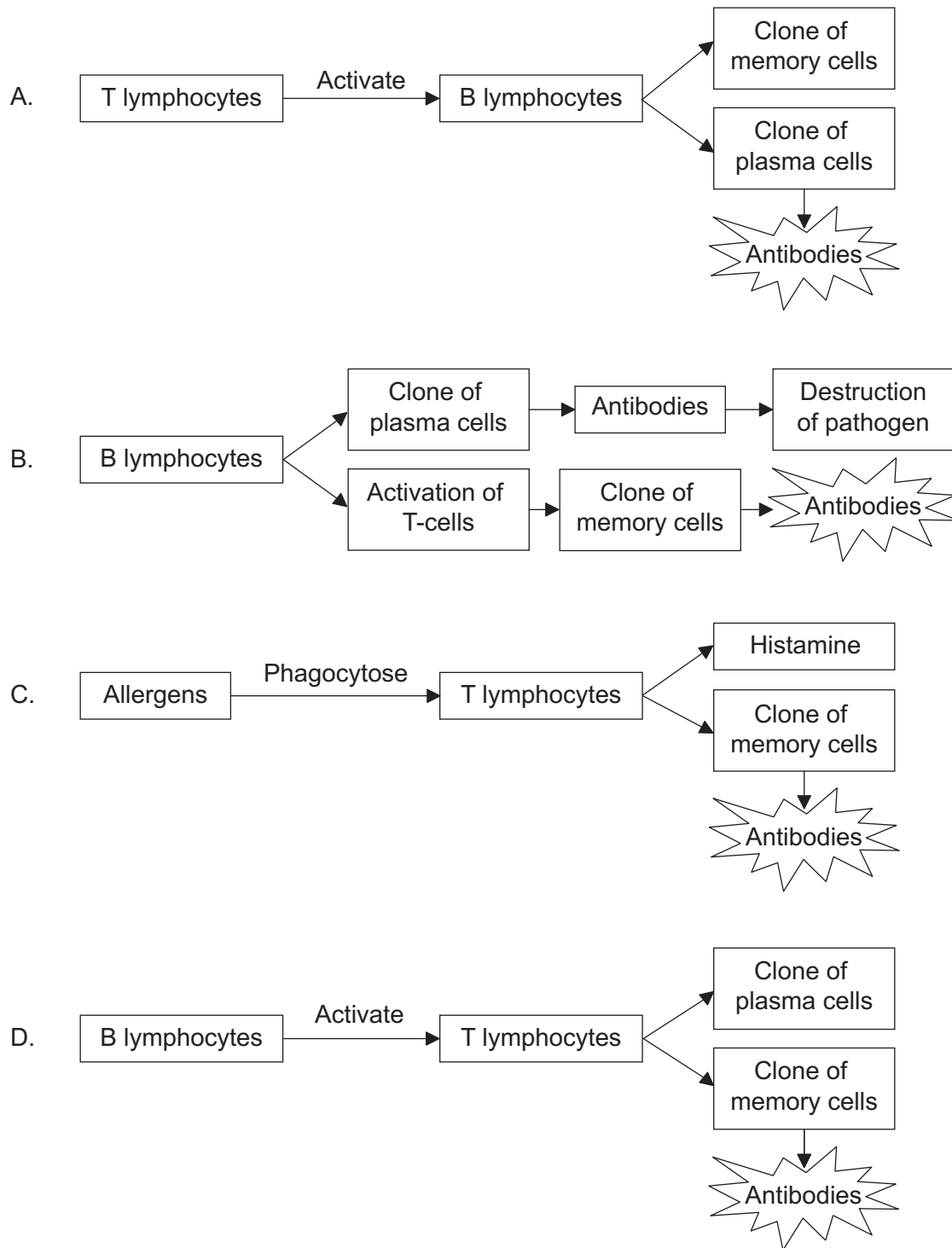
33. What happens to starch in the small intestine?
- A. Endopeptidase secreted by the liver digests starch to enable absorption by the villi.
  - B. Contraction of intestinal muscle mixes starch with enzymes to accelerate its conversion into amylose.
  - C. Glycogen secreted by the pancreas hydrolyses starch into glucose, which is eventually transported to the liver.
  - D. Amylase secreted by the pancreas digests starch to enable absorption by the villi.
34. In which process is “surface area” of key importance for humans?
- A. Reabsorption of glucose in the proximal convoluted tubule
  - B. Release of surfactants by type I pneumocytes
  - C. Display of antibodies by red blood cells
  - D. Secretion of enzymes by villi of the small intestine
35. Which discovery was an indication that the heart pumps blood to the body through arteries?
- A. The amount of blood pumped exceeds that of blood produced
  - B. Blood could easily be pushed up a limb vein, but not down
  - C. The observation that there were pores between the right and left atria
  - D. The heart swelled up when the arteries were tied in an animal experiment
36. Which is a valid comparison between arteries and veins?

	Arteries	Veins
A.	carry oxygenated blood	carry deoxygenated blood
B.	return blood to the atria of the heart	blood flows from ventricles to body tissues
C.	blood flows at high pressure	blood flows at low pressure
D.	have thick walls	have permeable walls

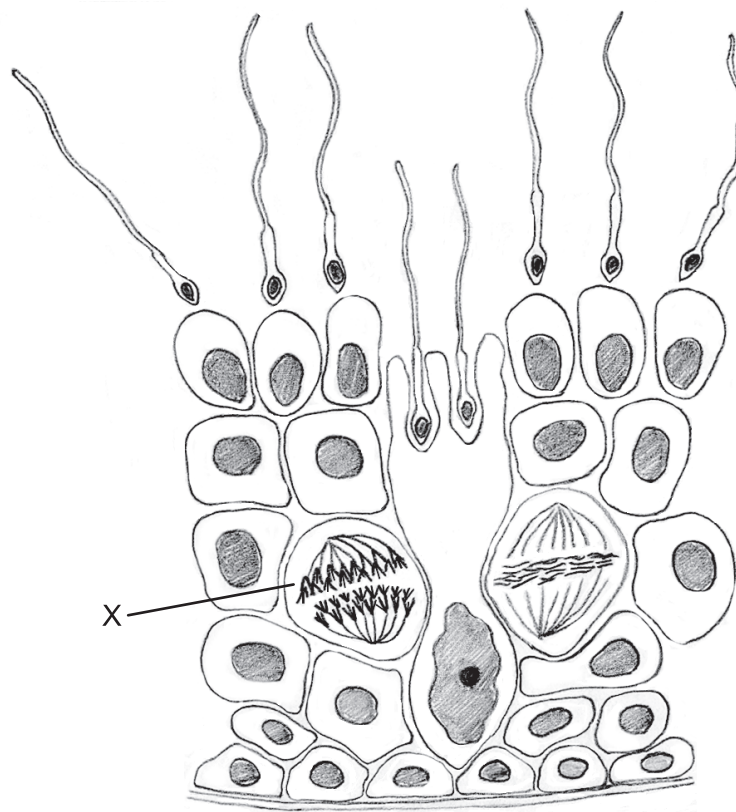


37. Which statement is true for the antibiotic penicillin?
- A. Watson and Crick developed the usage of penicillin.
  - B. Penicillin blocks processes unique to eukaryotic cells.
  - C. Viruses lack metabolism and penicillin has no effect on them.
  - D. Florey and Chain sequenced the genome of *Penicillium notatum*.
38. Which process is part of the mechanism that controls muscle contraction?
- A. Troponin enables actin heads to attach to ATP and slide along myosin.
  - B. Myosin heads attach to troponin and tropomyosin pulls on actin filaments.
  - C. Tropomyosin attaches to calcium and breaks the bond between actin and myosin.
  - D. Calcium frees actin filaments for myosin heads to attach.

39. Which sequence of events leads to the production of antibodies?



40. The image shows a section of a seminiferous tubule.



[Source: © International Baccalaureate Organization 2016]

What is shown by the letter X?

- A. Meiosis I in a primary spermatocyte
  - B. A spermatogonium undergoing mitosis
  - C. Meiosis II in a secondary spermatocyte
  - D. A spermatid undergoing meiosis
-